

## **I – Problem Statement Title (04-EQ017)**

### **Emergency Repair of Damaged Bridge Columns Using Fiber Reinforced Polymer (FRP) Materials**

## **II – Research Problem Statement**

**Question: Can FRP composite materials effectively be used to provide fast response emergency repair of bridge columns, reducing the traffic impacts due to bridge closures, following an extreme seismic event?**

## **III – Objective**

Develop the following:

- a) Establish degree of effective repairable damage using FRP through testing.
- b) Develop no-analysis prescriptive procedures/guidelines for using FRP composite materials for emergency repair of damaged columns due to an earthquake, high load impact, or blast.
- c) Material selection/specifications of FRP composite materials used for emergency repair of damaged bridge columns.

## **IV – Background**

During an earthquake of large magnitude, bridge columns may be severely damaged limiting the functional capacity of the bridge. In cases where the columns are damaged but the bridge is still standing, the structure may be shored up until repair is complete. Shoring primarily provides dead load and live load capacity; however, shoring does not typically provide significant lateral or shear capacity. Subsequent aftershocks/ground motion may cause additional failure and possible bridge collapse. Therefore, it is proposed that damaged columns which will ultimately require repair or replacement be temporarily wrapped with composite material. A fast curing FRP wrap will provide the needed confinement and lateral capacity to mitigate further damage, which may be caused due to aftershocks; and thereby, providing the necessary time to conduct the required bridge repair.

## **V –Statement of Urgency and Benefits**

### **A. Support of the Department's Mission/Goals**

**(Improving Mobility: Safety, Reliability and Productivity)** These goals are realized by the potential to keep routes open, and reduce further damage after a major earthquake and subsequent aftershocks by providing temporary supplemental confinement and lateral capacity to bridge columns using FRP materials. Providing supplemental confinement

using FRP composite materials makes it possible to maintain the vertical and lateral load carrying capacity of bridges, which may otherwise be closed due to column damage, and thereby improve safety and reduce the traffic delays on an already strained system after an earthquake.

**B. Return on Investment:**

The return on the investment of this research is very high from both an economic and sociological perspective. The cost savings to the traveling motorist by being able to keep open even one traffic route can result in several million dollars on a daily basis, also the potential cost saving to the Department can be millions by preventing further damage or collapse of only one structure due to subsequent aftershocks.

**VI – Related Research**

FRP column jacket strengthening / Pre-qualification program for seismic retrofit of bridge columns using FRP composite materials. (USC, UCI, UCSD research)

**VII – Deployment Potential**

High rapid deployment potential can be immediate after conducted research verifies procedures. DOT Maintenance Department can keep a supply of material on hand or a list of suppliers and installers available and ready to go in the event of an emergency.